

**Claims**

1. In a GM, Solvay, or GM type pulse tube refrigerator, a valve assembly comprising
  - 5 a motor driven rotating valve disc, and
  - a non-rotating valve seat,where different pressures exerted against at least two surfaces of the valve seat result in a net force such that the rotating valve disc is forced in a direction toward the valve motor.
- 10 2. A valve assembly in accordance with claim 1 in which the non-rotating valve seat can move axially and the rotating valve disc is restrained from moving axially
- 15 3. A valve assembly in accordance with claim 2 in which
  - a first of the at least two surfaces of the valve seat is in a central cavity in the valve seat, the cavity being connected to system high-pressure gas;
  - a second of the at least two surfaces of the valve seat is in the annular area between the central cavity in the valve seat and the outside of the valve
  - 20 seat where the second surface is connected to one of system low-pressure gas or gas at a pressure between the system high pressure and vacuum; and
  - both first and second of the at least two surfaces are distal to the face of the valve disc.
- 25 4. A valve assembly in accordance with claim 3 in which the second of the at least two surfaces is connected to pulse tube buffer gas pressure.
5. A valve assembly in accordance with claim 2 in which
  - a. a first of the at least two surfaces of the valve seat is in a central cavity
  - 30 in the valve seat, the cavity being connected to one of system low-pressure gas or gas at a pressure between the system high pressure and vacuum;

- b. a second of the at least two surfaces of the valve seat is in the annular area between the central cavity in the valve seat and the outside of the valve seat where the second surface is connected to system high pressure; and
- 5 c. both first and second of the at least two surfaces are distal to the face of the valve disc.
6. A valve assembly in accordance with claim 5 in which said first surface is connected to pulse tube buffer gas pressure.
- 10 7. A valve assembly in accordance with claim 1 wherein a first surface of the valve seat is the distal end of the valve seat, the surface being connected to pulse tube buffer gas pressure, and a second surface of the valve seat is in the annular area between the valve
- 15 disc and the outside of the valve seat and the second surface is connected to one of system low-pressure gas or high-pressure gas.
8. A valve assembly in accordance with claim 1 in which the axial force is carried by one of the valve motor shaft bearings and a separate bearing.
- 20 9. In a GM, Solvay, or GM type pulse tube refrigerator a valve assembly comprising
- a. an axially non-movable motor driven rotating valve disc,
- b. a non-rotating axially movable valve seat,
- 25 c. where different pressures exerted against at least two surfaces of the valve seat result in a net force such that the rotating valve disc is forced in one of the direction toward the valve motor and of the direction away from the valve motor.
- 30 10. A valve disc in accordance with claim 9 in which the force pushes said valve disc in the direction away from the valve motor.

11. A valve seat in accordance with claim 9 in which

- a. a first surface is the annular area between the valve disc and the outside of the valve seat, said surface being connected to high-pressure.
- b. At least one second surface distal to said first surface, said surface being connected to one of gas pressure from a pulse tube buffer tank and low-pressure.

5

10